DRAFT PROTOCOL FOR CY 2008

SOURCE TEST PROTOCOL
LOUDOUN COUNTY SOLID WASTE MANAGEMENT
EVERGREEN MILLS ROAD LANDFILL

LFG GROUND FLARE

February 27, 2003

Prepared for:

Office of Solid Waste Management, Loudoun County
1 Harrison Street, S.E.
Leesburg, Virginia 20175

Prepared by:

Applied Environmental Consultants, Inc.
2465 W. 12th Street, Suite 6
Tempe, Arizona 85281

DRAFT PROTOCOL FOR CY 2008

TABLE OF CONTENTS

DRAFT PROTOCOL FOR CY 2008

LIST OF FIGURES

LIST OF TABLES

DRAFT PROTOCOL FOR CY 2008

1. INTRODUCTION

Source emission testing will be conducted at the Loudoun County Municipal Solid Waste Landfill, 20933 Evergreen Mills Road, Leesburg, Virginia, in order to demonstrate compliance with applicable permit conditions (Reg. No. 72348) as listed in §12 of the facility's current Operating Permit. Measurements of the flare emissions and operating parameters will be conducted at the flare exhaust and the inlet of the flare. Table 1.1 provides a test matrix of the parameters to be tested at each sampling location.

Table 1.1 Test Matrix – Loudoun County Solid Waste Landfill Flare

Parameter	Inlet	Exhaust
Oxygen (O_2)	X	X
Carbon Dioxide (CO_2)	X	X
Nitrogen (N_2)	X	X
Carbon Monoxide (CO)		X
Nitrogen Oxides (NO_x)		X
Sulfur Oxides (SO_x)		X
Flow Rate (dscfm)	X	X
Temperature (°F)	X	X
Methane (CH_4)	X	X
Non-Methane Organics (NMOC)	X	X

1.1 FACILITY AND UNIT DESCRIPTION

Loudoun County Office of Solid Waste Management (LCOSWM) owns and operates an enclosed ground flare at the Evergreen Mills Road Landfill which is located on Route 621, approximately 5 miles southeast of Leesburg, Virginia.

As the refuse in the landfill decomposes, gases are generated in the ground which contains methane and other decomposition byproducts. The landfill gas (LFG) is collected using vertical and horizontal gas wells located in the landfill and along the perimeter. A gas collection header connects all gas wells to the flare station. The header is designed to slope continuously to low points throughout the system in order to prevent condensate from accumulating in the pipe. Condensate generated when the LFG cools in the header is drained and pumped to a central collection point.

The landfill gas is delivered to the flare system utilizing a blower that has the capacity to process up to 450 scfm of LFG. The collected gas is incinerated at a temperature in excess of 1400° F using special low NOx burners at the base of the enclosed flare. During the disposal, the temperature is controlled to ensure efficient removal of pollutants, thus preventing their release into the atmosphere.

The flare consists of a vertical, round, blanket refractory lined shell with main and ignition burners located near the base. The ignition burner fires propane and landfill gas. The main burner fires only landfill gas. The flare is equipped with inlet air dampers to control the flow of combustion air to the burners. Thermocouples are installed at various heights to provide temperature indication for control of combustion temperature. A flow meter monitors the flow rate of the landfill gas at the inlet of the flare, just prior to the main burner.

LFG Specialties, Inc. manufactured and installed the enclosed landfill gas flare. The unit (Model EF735110) has a diameter of 7 feet and is 35 feet in height. The flare is rated at burning 450 scfm of LFG at a temperature in excess of 1400° F and with a residence time of more than 0.6 seconds. The thermal capacity of the flare is ~10 MMBtu/hr. The anticipated landfill gas flow is lower than the flare capacity because the landfill gas supply is presently limited.

1.2 FACILITY AND TEST FIRM INFORMATION

Information on the owner and facility location, and firms involved with the emissions testing program is provided in Table 1.2.

Table 1.2 Facility and Test Firm Information

Owner	Contact
Office of Solid Waste Management, Loudoun County 1 Harrison St., S.E., P.O. Box 7000 Leesburg, Virginia 20175	Mr. Richard Webber Director (703) 777-0136
Facility	**Contact**
Loudoun County Solid Waste Landfill 20933 Evergreen Mills Rd. Leesburg, Virginia 20175	Mr. Michael Ball Engineer (703) 737-8678
Test Firm	**Contact**
Applied Environmental Consultants, Inc. 2465 W. 12th Street, Suite 6 Tempe, Arizona 85281	Mr. Russell Gossett Sr. Scientist / Project Manager (480) 829-0457
Analytical Laboratory	**Contact**
Research Triangle Park Laboratories 8109 Ebenezer Church Rd. Raleigh, North Carolina 27612	Mr. Roy Gorman Laboratory Director (919) 510-0228

2. TESTING METHODS AND PROCEDURES

2.1 TEST SCHEDULE

Testing is scheduled for April 1, 2003. Pending on the regulatory agency's approval, testing should commence at approximately 0900 hours.

2.2 TESTING METHODS

Table 2.1 specifies the test methods to be used during the testing program. Unless deviations are specified in Section 2.4 below, all tests will conform to the applicable methodologies specified in the appendices to 40 CFR Part 60. Testing will consist of three, 60 minute, reference-method test runs conducted simultaneously at the inlet and the outlet of the flare. Emissions will be calculated as the average of the three test runs for efficiency calculations and comparison with applicable emission limits. Destruction efficiency will be calculated on a mass basis.

It is anticipated that the exhaust flow rates will be below the measurable ranges of the EPA Method 2 conventional equipment. Consequently, AEC will determine the volumetric flow rates based on the waste gas consumption rates, the stack gas O_2 content, the F-factor and gross calorific values (40 CFR Part 60, Appendix A, Method 19, and landfill gas analysis) which will be established from the laboratory analysis of the landfill gas.

Alternate to the procedure outlined above, in the case where exhaust flow rates can be measured with the conventional equipment, AEC will perform simultaneous moisture measurements and flow traverses at the inlet and outlet of the flare, concurrent with each continuous emissions monitoring (CEM) run.

Since the enclosed ground flare is fired on landfill gas, speciation of the organic compounds, reporting methane and non-methane concentrations on the inlet and outlet of the system, will be required. In order to achieve this, AEC proposes to collect integrated Tedlar® bag samples via rigid container (per EPA Method 18, Figure 18-9) and have them analyzed by a certified laboratory based on EPA Method 25C.

Table 2.1 Test Methods

Emission Unit	Emission Species	Test Method
LFG Ground Flare Outlet	NO_x	EPA Method 7E
	CO	EPA Method 10
	SO_2	EPA Method 6C
	O_2/CO_2	EPA Method 3A
	NMOC	EPA Method 25C/18
	Flow	EPA Method 1-4 or 19
LFG Ground Flare Inlet	NMOC	EPA Method 25C/18
	Flow	Dedicated Gas Meter

DRAFT PROTOCOL FOR CY 2008

2.3 SAMPLING EQUIPMENT DESCRIPTION

Table 2.2 lists the gaseous analyzers to be used in the test program. Stack gas is extracted through a stainless steel in-stack probe, heated Teflon tubing, and sample conditioner that cools and dries the stack gas sample. The conditioned sample gas continues through Teflon tubing to the gas manifold where it is distributed to EPA approved instrumental analyzers. Excess stack gas is vented to the atmosphere. Zero and calibration gases can be introduced directly into each analyzer via the manifold or directed to the probe tip for bias checks. The gas manifold is constructed of Teflon tubing and stainless steel solenoids and fittings. Figure 2.1 illustrates the multi-component gaseous sampling train.

Data recording will be performed with the aid of an ESC Model 8816 data logger. Each instrument output will be recorded continuously and the data collected will be averaged and stored into the data logger every sixty seconds. Data retrieval into an IBM compatible computer will be done through the RS-232 communication port with the aid of AEC's proprietary software which is capable of recording the data directly into an Excel® spreadsheet on a minute-by-minute basis.

Methane and NMOC samples will be collected following the sampling procedures outlined in EPA Method 18. The landfill gas samples will be collected over a sixty minute period in new Tedlar® bags. The sample will be collected using a stainless steel probe connected by Teflon tubing to the sample bag. The Tedlar® bag is enclosed in a rigid container which is under a pre-determined, constant vacuum, thus forcing the gas sample directly into the bag at a constant rate. The probe and sample line are purged with inlet or flue gas continuously for approximately 5 minutes before sampling.

Table 2.2 Monitoring Equipment Description

Parameter	Analyzer Manufacturer	Instrument Model	Operating Principle
CO	TECO	Model 48C	Gas Filter Correlation/Infrared
NOx	TECO	Model 42C	Chemiluminescence
SO_2	AMETEK	Model 921	Ultraviolet Photometric
CO_2	California Analytical	Model ZRH	Non-Dispersive Infrared
O_2	Siemens	Model Oxymat 6E	Paramagnetic

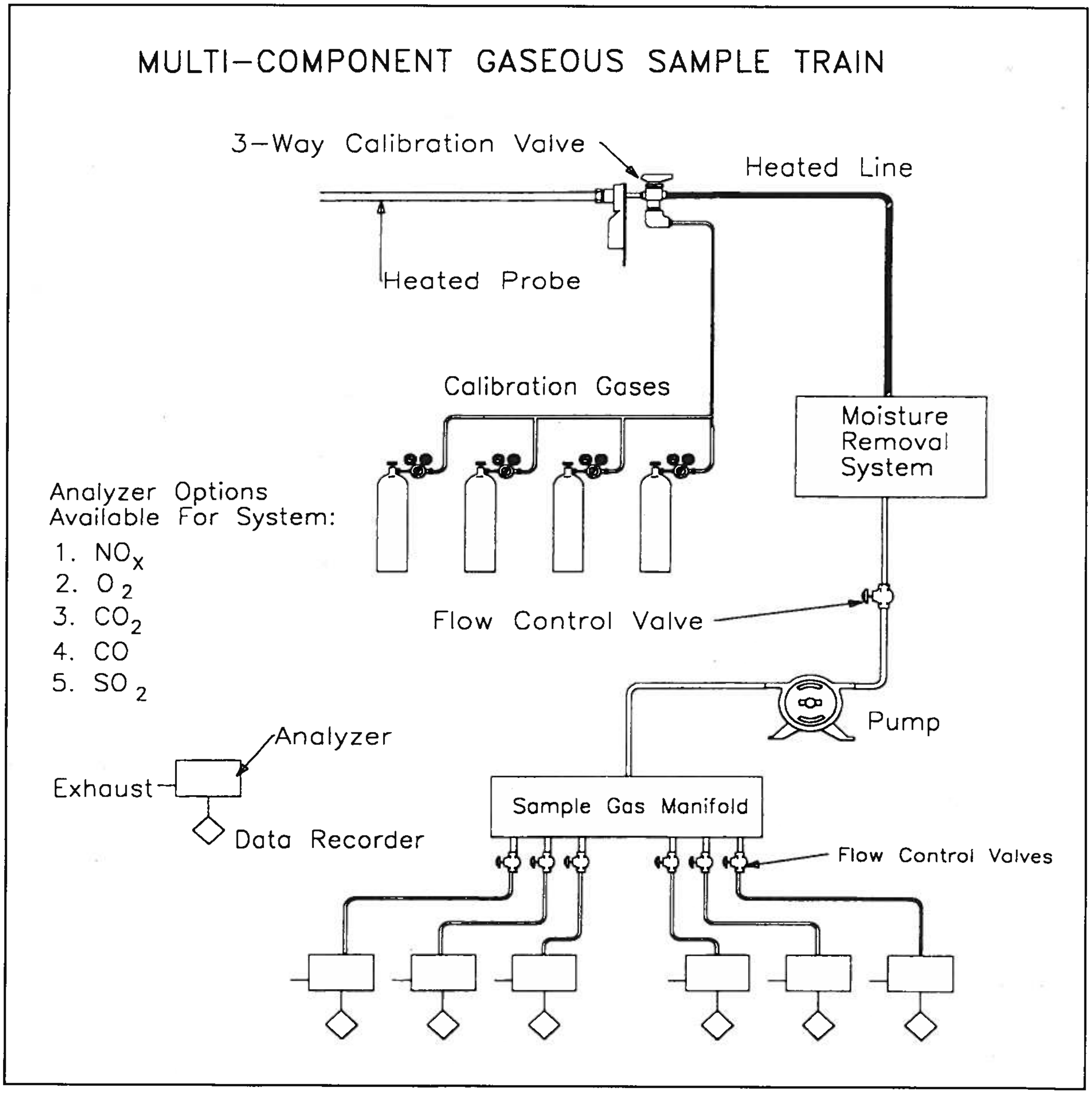


Figure 2.1 Schematic of Gaseous Sampling System.

Sampling trains for moisture will conform to the guidelines specified in EPA Method 4. A diagram of the sampling trains to be used during the test is presented in Figure 2.2.

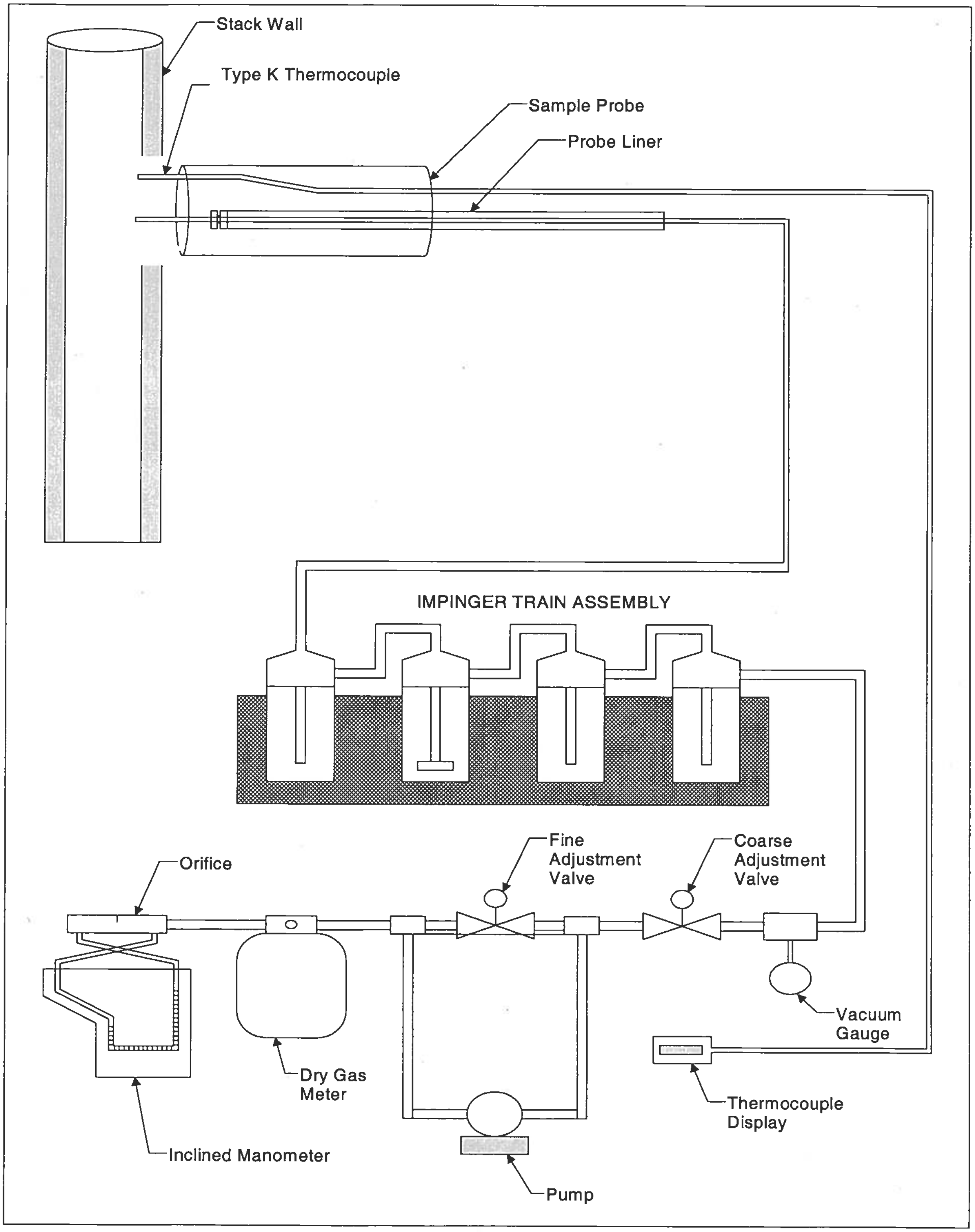


Figure 2.2 EPA Method 4 Sampling Train.

DRAFT PROTOCOL FOR CY 2008

2.4 METHOD DESCRIPTIONS

The following is a brief summary of each of the applicable test methodologies to be employed during the testing program. Complete method descriptions are presented in the appendices to 40 CFR Part 60.

2.4.1 EPA Method 1: Sampling and Velocity Traverses for Stationary Sources

Prior to the source test, a site assessment will be performed in order to locate sample points for obtaining the best representative measurements of pollution concentrations and volumetric flow rates. EPA Method 1 takes into account duct area, straight run and cyclonic or stratified flow patterns.

2.4.2 EPA Method 2: Determination of Velocity and Volumetric Flow Rates

EPA Method 2 will be used to determine stack gas velocity and volumetric flow rates. A calibrated type-S pitot tube will be connected to an inclined manometer and leak checked. Stack gas temperature and manometer displacement (delta P) will then be recorded at each traverse point and a duct static pressure will also be measured and recorded. Stack gas velocity and volumetric flow rate will then be calculated in accordance with EPA Method 2.

2.4.3 EPA Method 3: Determination of Percent CO_2, O_2, and Dry Molecular Weight

Concurrent with each sample run, an integrated gas sample will be withdrawn directly from the inlet duct and collected into a Tedlar® bag. The stack gas sample will be analyzed by Orsat for fixed gas composition and determination of stack gas dry molecular weight.

2.4.4 EPA Method 3A: Determination of CO_2, O_2, and Dry Molecular Weight by Instrumental Analyzer

A gas sample is continuously extracted from the stack through a stainless steel sample probe into a condenser to cool and dry the sample, through Teflon sample line, and continuous O_2 and CO_2 analyzers. Continuous O_2 and CO_2 measurements in percent are recorded on a strip chart recorder and/or data acquisition system. The O_2 and CO_2 analyzers are calibrated prior to sampling using zero, mid-range, and high range EPA protocol gases. Following each test run, a sampling system bias check is performed by introducing zero and upscale (either mid-range or high range) EPA Protocol gas into the sampling system at the back end of the sample probe. Prior to and following each run, a zero and calibration check is performed by introducing zero and upscale (either mid or high range) EPA Protocol gas into the analyzer. Dry molecular weight of the stack gas is calculated using the measured O_2 and CO_2 concentrations.

2.4.5 EPA Method 4: Determination of Stack Gas Moisture Content

Stack gas moisture content will be determined concurrently with each gaseous run. Impinger weights will be determined prior to and following sampling. Stack gas moisture content will be determined from the mass of the water collected and the sample gas volume.

2.4.6 EPA Method 6C: Determination of Sulfur Dioxide Emissions

A gas sample is continuously extracted from the stack through a stainless steel sample probe, into a condenser to cool and dry the sample, through a Teflon sample line, and into a UV photometric absorption SO_2 analyzer. Continuous SO_2 measurements are recorded on a strip chart recorder and/or data acquisition system. The SO_2 analyzer is calibrated prior to sampling using zero, mid-range, and high range EPA Protocol gases. Following the test runs, a sampling system bias check is performed by introducing zero and upscale (either mid-range or high range) EPA Protocol gas into the sampling system at the back end of the sample probe. Prior to and following each run, a zero and calibration check is performed by introducing zero and upscale (either mid or high range) EPA Protocol gas into the analyzer.

2.4.7 EPA Method 7E: Determination of Nitrogen Oxides Emissions

A gas sample is continuously extracted from the stack through a stainless steel sample probe, into a condenser to cool and dry the sample, through a Teflon sample line, and into a chemiluminescent NO_x analyzer. Continuous NO_x measurements are recorded on a strip chart recorder and/or data acquisition system. The NO_x analyzer is calibrated prior to sampling using zero, mid-range, and high range EPA protocol gases. Following the test runs, a sampling system bias check is performed by introducing zero and upscale (either mid-range or high range) EPA Protocol gas into the sampling system at the back end of the sample probe. Prior to and following each run, a zero and calibration check is performed by introducing zero and upscale (either mid or high range) EPA Protocol gas into the analyzer.

2.4.8 EPA Method 10: Determination of Carbon Monoxide Emissions

A gas sample is continuously extracted from the stack through a stainless steel sample probe, into a condenser to cool and dry the sample, through Teflon sample line, and into a gas filter correlation CO analyzer. Continuous CO measurements are recorded on a strip chart recorder and/or data acquisition system. The CO analyzer is calibrated prior to sampling using zero, mid-range, and high range EPA protocol gases. Following the test runs, a sampling system bias check is performed by introducing zero and upscale (either mid-range or high range) EPA Protocol gas into the sampling system at the back end of the sample probe. Prior to and following each run, a zero and calibration check is performed by introducing zero and upscale (either mid or high range) EPA Protocol gas into the analyzer.

2.4.9 EPA Method 18/25C: Measurement of Gaseous Organic Compound Emissions by GC/Determination of Non Methane Organic Compounds

Gas samples will be extracted individually from the inlet to the flare and the stack outlet through a Teflon sample line and into 5-liter Tedlar® bags (as illustrated in EPA Method 18, Figure 18-9). On completion of each run, the sample is labeled and immediately transported to a certified laboratory. Analysis is performed with in 72 hours of sampling. The analysis (EPA Method 25C) performed by Total Carbon Analysis/Flame Ionization Detector (TCA/FID) gives results of CH_4, CO_2 and total non-methane organics as CH_4. All non-methane organics (NMOC) are oxidized to CO_2 then reduced back to methane and then measured by flame ionization. All carbon contained in the original non-methane portion is therefore converted to methane and the results are reported as total gaseous non-methane organics (TGNMO). Laboratory NMOC results will be reported in ppm and lb/hr emission rate as hexane and will be used to calculate the destruction efficiency of the flare.

2.4.10 EPA Method 19: Determination of Emission Rates

The stack gas volumetric flow rate will be determined based on the waste gas consumption, the F-factor and gross calorific values (40 CFR Part 60, Appendix A, Method 19, and landfill gas analysis), and the stack gas O_2 content utilizing the following equation:

$$DSCFM = \frac{Fuel(scfm) * \frac{Btu}{ft^3}}{1{,}000{,}000} * F\_factor * \frac{20.9}{20.9 - Stack\_O_2\%}$$

2.5 METHOD DEVIATIONS

Sampling based on EPA Methods 3A, 6C, 7E and 10 will be performed following the principles of EPA Method 6C since SO_2, NOx, CO, CO_2, and O_2 measurements will be performed simultaneously using one sample extraction and conditioning system.

3. EMISSION POINT INFORMATION

3.1 TRAVERSE POINT LOCATIONS

Figure 3.1 shows the sample port locations and appropriate stack dimensions for the outlet duct. A figure showing the system layout and configuration is included in Appendix C of this protocol. Traverse point locations for the outlet duct will be determined following EPA Method 1 prior to testing. Table 3.1 and Figure 3.2 show the flow traverse point locations based upon the preliminary stack data provided by LCOSWM.

Table 3.1 Traverse Point Locations - Outlet

Stack Diameter is approximately 84.0 inches

Point	Distance from Stack Wall (in)	Point	Distance from Stack Wall (in)
1	1.8	7	54.1
2	5.6	8	63.0
3	9.9	9	69.1
4	14.9	10	74.1
5	21.0	11	78.4
6	29.9	12	82.2

DRAFT PROTOCOL FOR CY 2008

3.2 PROCESS CONDITIONS AND ESTIMATED STACK GAS PARAMETERS

During the months of December 2002 and January 2003, the LFG collection system operated as designed, however the volume of gas produced by the landfill has diminished as a result of slow degradation of the waste, age of the landfill, and type of waste in the landfill. Because this low gas production was predicted, LCOSWM received concurrence from the DEQ to operate the gas system during the week, shutting down over the weekend to allow recovery of the gas in the landfill. The current flow through the system is between 99-244 scfm, when operating. It is anticipated that the ground flare and all process equipment will be operated at these conditions during the scheduled compliance test. Table 3.2 lists the anticipated stack gas parameters.

Table 3.2 Anticipated Stack Gas Parameters

Emission Unit	Volumetric Flow Rate (dscfm)	Stack Gas Temperature (°F)	Moisture Content (%)	Anticipated Stack Gas Concentrations
LFG Ground Flare Outlet	1,200	1400-1600	10%	NOx – 20 ppm CO – 50 ppm SO_2 – 2 ppm VOC – 20 ppm O_2 – 13% CO_2 – 6%

DRAFT PROTOCOL FOR CY 2008

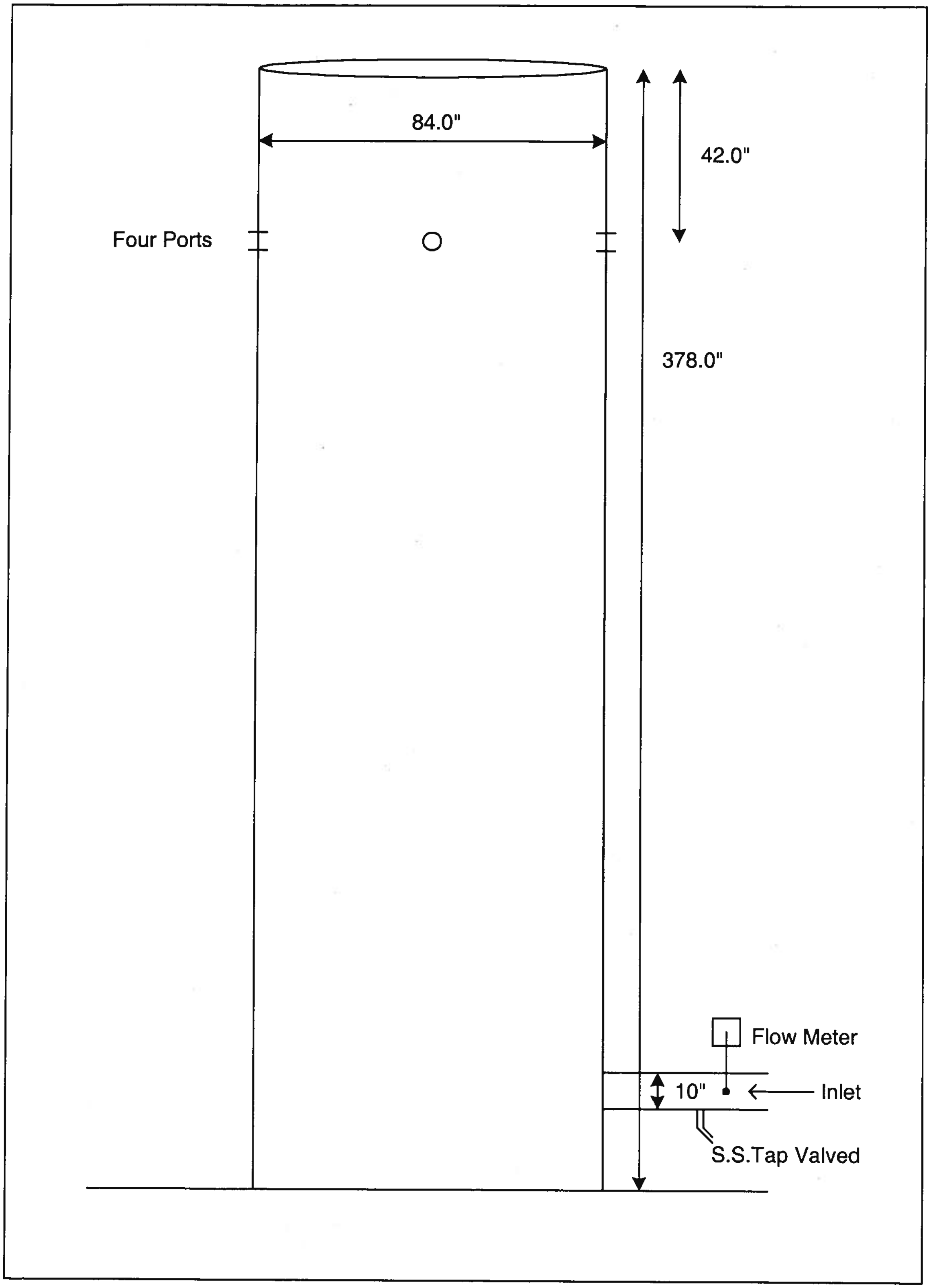


Figure 3.1 Stack sample port locations and stack dimensions.

DRAFT PROTOCOL FOR CY 2008

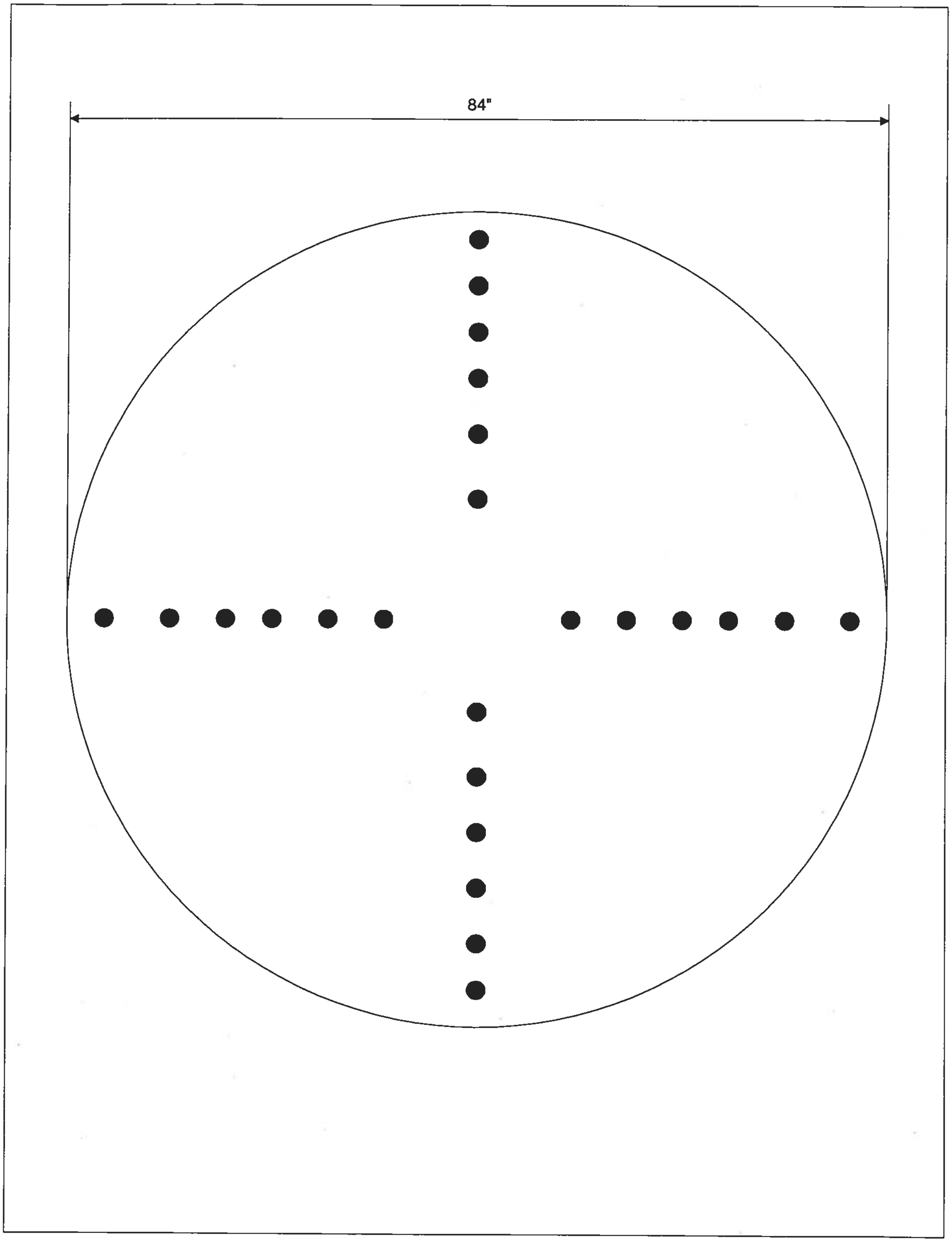


Figure 3.2 Outlet duct traverse point locations (see text for exact dimensions).

DRAFT PROTOCOL FOR CY 2008

4. CONTROL EQUIPMENT INFORMATION

4.1 CONTROL EQUIPMENT DESCRIPTION

Table 4.1 presents the applicable information regarding the pollution control equipment.

Table 4.1 Control Equipment Information

Item	Description
Type of Control	Enclosed Ground Flare
Manufacturer	LFG Specialties, Inc.
Model Number	EF735110
Rated Capacity	450 cfm of LFG
Rated Efficiency	>98%

4.2 CONTROL EQUIPMENT INFORMATION TO BE MONITORED

Control equipment to be monitored during testing includes the combustion gas temperature and damper setting. The flare is required to maintain a minimum temperature of 1400° Fahrenheit unless it can be demonstrated through testing that compliance can be achieved at a lower temperature. These operational parameters are to be monitored and recorded every 15 minutes during testing.

5. PROCESS UNIT INFORMATION

5.1 PROCESS EQUIPMENT DESCRIPTIONS

Table 5.1 presents the applicable process equipment information for the three flares.

Table 5.1 Process Equipment Information

Item	Description
Type of Equipment	Enclosed Ground Flare
Manufacturer	LFG Specialties, Inc.
Typical Process Capacity	450 cfm of LFG
Type of Materials Processed	Landfill Gas

5.2 PROCESS EQUIPMENT INFORMATION TO BE MONITORED

LCOSWM will monitor at a minimum the total process operating time, date, inlet gas line pressure, and waste gas flow rates. These parameters are to be monitored and recorded every 15 minutes during testing.

6. RESULTS PRESENTATION

6.1 DATA REDUCTION

Data collected during the source test will be processed in accordance with the applicable EPA Methods. All laboratory analyses will be performed by a certified lab within 72 hours of sample collection.

6.2 SAMPLE DATA SHEETS

Data sheets that will be used during the testing program are presented in Appendix A.

6.3 DATA REPORTING

Complete test results will be presented in a final test report to be submitted to Virginia Department of Environmental Quality within 45 days of the completion of the test program. This report will present all field data sheets, laboratory analysis results, applicable process/control equipment information, quality assurance information, and test results.

7. QUALITY ASSURANCE / QUALITY CONTROL

Quality assurance procedures will be performed in accordance with those listed in the appropriate test method, the *Commonwealth of Virginia State Air Pollution Control Board's Regulations,* and the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3.*

AEC ensures the quality and validity of its emission measurement and reporting procedures through a rigorous quality assurance program. The quality assurance procedures for the filed work include, but are not limited to:

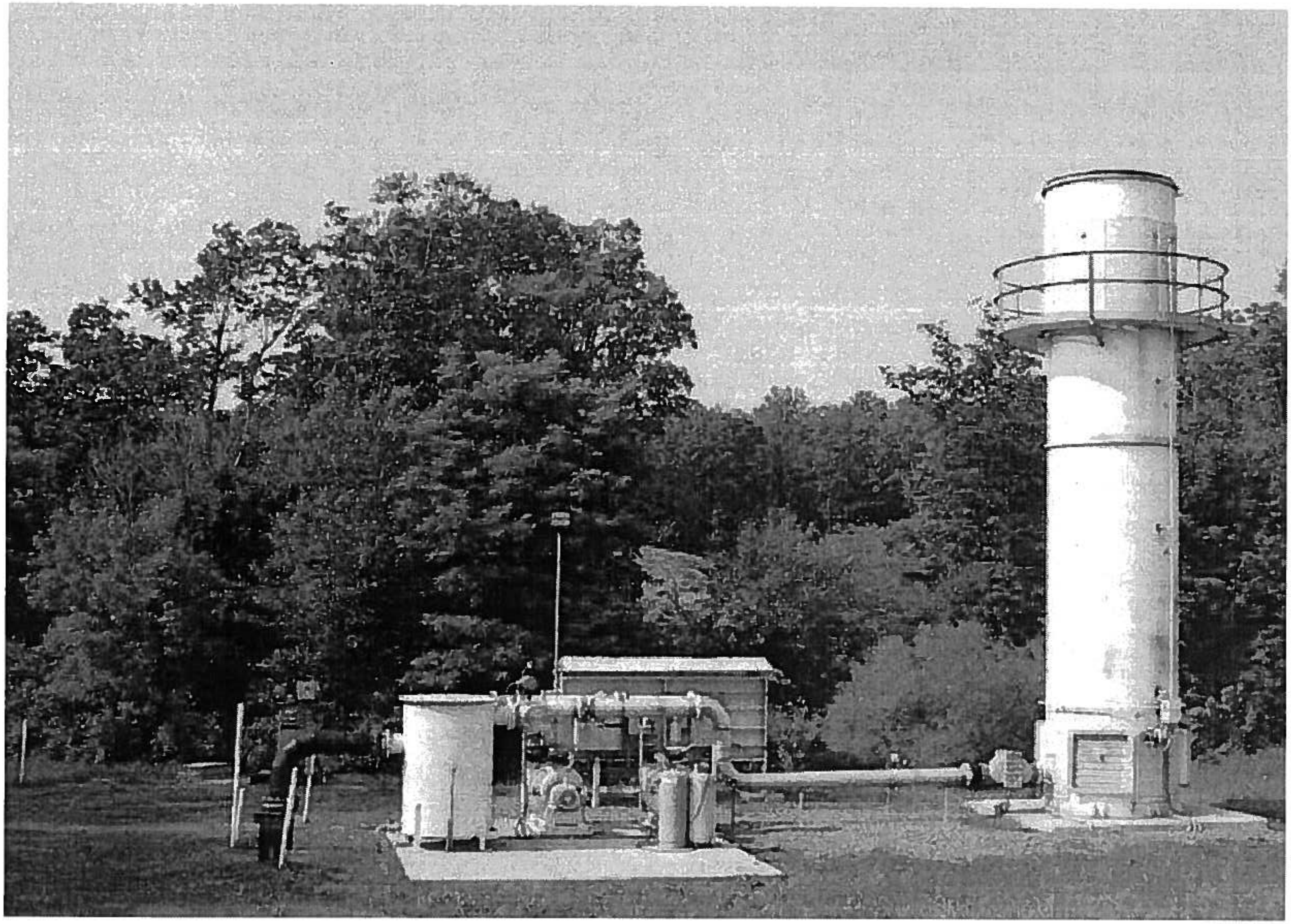
- Inspection and calibration of the type-S pitot tube prior to and following use to confirm proper design criteria specified in EPA Method 2.
- Calibration of the stack temperature sensor against an ASTM thermometer prior to sampling.
- Leak checks of the sampling system after each sample run including the sample train, manometers and pitot tube lines.
- Calibration of the dry gas meter prior to and after sampling.
- Inspection of all glassware to ensure cleanliness and lack of contaminants.
- Preparation and analysis of a full set of field blanks.
- Sample tracking through use of Chain of Custody forms.
- Complete multipoint calibration of gaseous analyzers using EPA Protocol gases.
- Zero and upscale bias checks of the gaseous analyzers before and after each test run.
- Assurance that the sample line heater operates properly.

All calibration sheets for the dry gas meter, pitot tubes, and other applicable test equipment will be available on-site prior to testing.

APPENDIX A
SAMPLE FIELD DATA SHEETS

APPENDIX B
OPERATING PERMIT

APPENDIX C
ILLUSTRATIONS



Loudoun County Solid Waste Landfill – LFG Control System